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ABSTRACT

This paper presents the advantages of computer generated tests over traditional tests, outlines the procedures followed in developing a test of music fundamentals, and concludes with the results of a trial of the test. The test, which was developed and programmed in BASIC at Oregon State University, covers elements of notation, intervals and triads, song identification, meter identification, scales, solmization, major western composers, and their principal works. Subjects for the trial of the test were 95 students from freshman theory and basic musicianship courses and juniors in music education. (CMV)

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THE DEVELOPMENT AND TRIAL OF A COMPUTER MANAGED TEST OF MUSIC FUNDAMENTALS

A Paper
Prepared for
The Oregon Council for Research in Teacher Education

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by

Rebecca Herrold
Oregon State University

given November 16, 1977

IR007337

I. Introduction

A test that is programmed into a computer provides options for an instructor that are unavailable in tests generated in the traditional manner--options that are sufficiently attractive that antitechnology prejudices in some people may be overcome. First, a computer has the capacity to store questions in categories relative to topic and difficulty. From this question "bank" an instructor may make up an examination that is appropriate for a particular student or group by instructing the computer to print questions from one or more categories or levels of difficulty, selecting either specific questions from a category or randomized questions from a category. Further, a computer may also be requested to randomize all the questions for a group examination, so that each test has an individual question order. Tests are printed quickly and inexpensively, or may be completely machine administered at computer terminals on teletypes or graphics hardware. In the latter, no paper is involved in giving a test, and the student responses are recorded and scored immediately.

Music departments in higher education often administer theory and literature examinations to entering freshmen. When these tests must be hand graded and recorded, the task is so time-consuming that the lapse of time

between pre-registration and the onset of classes does not permit the use of the tests for class placement purposes; the data simply becomes a part of the student's record or serves as a means for denial of admission.

An obvious advantage of computer-scored tests, then, is the computer's ability to process data at extremely high speed, an especially important feature when large numbers of exams must be scored within twenty-four hours or less. Moreover, computerized test scoring offers results that cannot be reasonably accomplished by hand. Valuable statistics become readily available: information about each student, the class, the test, and each of the items on the test. Whereas the mean and the class rank are easy to compute, others, like the item-difficulty index and the point biserial correlation are complex computations which are extremely difficult to calculate without the help of the computer. Such statistics help to make testing more reliable and assist instructors and departments in recognizing the shortcomings in their tests, as the computer can be instructed to assess the quality of every question on a test. This information enables a department to develop a consistently high-quality testing program for entrance, placement, competency, and graduation purposes.

Music departments, whose students are frequently derived from a diversity of academic and cultural backgrounds, are most helpful to their entering freshmen when they assess the students' theory and literature backgrounds, design cur-

ricula in these areas related to the class's evidence of prior achievement, and, in some instances, arrange advanced placement for some of those examined.

II. Procedures

In the fall term of 1977, a computer-managed test (CMT) of music fundamentals was developed and programmed on the Cyber in the BASIC computer language at the OSU Milne Computer Center. A trial of the examination was undertaken to determine the reliability of the test questions, the types of statistical information that would prove to be of interest to the music faculty, and the feasibility of administering the examination in subsequent terms.

Ninety-five students from four classes were tested. One of the classes represented the area of freshmen theory, two were classes in basic musicianship for the general university student, and the fourth was a class of junior music education majors. The tests were scored by group, and statistical information for the total number was also requested.

The computer generated ninety visual test questions in all, representing seven topical categories of questions: (1) elements of notation i.e. key signatures, time signatures, dynamic markings, and identification of pitch and rhythmic features in scores; (2) intervals and triads; (3) familiar folk song score identification; (4) meter identification; (5)scales; (6) solmisation; and (6) association of major western composers and their principal works, representative

of Renaissance, Baroque, Classical, Romantic, and Modern Periods in music history.

Computer scoring provided the following data for each group and cumulative data for the total number examined:

individual test scores

percentage--the student's scale converted to a scale of 0-100

Z-score-----a conversion which changes all student test scores to a scale in which the class mean is 0 and the standard deviations is 1

T-score-----a normalized standard score with a mean of 50 and a standard deviation of 10

Rank

Mean--------the measure of central tendency

Standard Deviation

--------an index of how the class scores are distributed

Median------the middle score in the class

Percentile--indicates what percent of the test scores are lower than that particular score

Percent-----the percentage of the class that received each test score

Frequency---the number of students who received each test score

Cumulative Frequency

---keeps a total of frequencies below each test score. For example, if a test score of 72 shows a cumulative frequency of 14, then 14 students in the class scored 72 or less

The computer was also requested to provide item-analysis statistics--a question-by-question statistical analysis of the test. This analysis gives assistance in

developing high-quality test questions.

Question Number.

Right Answer.

Group Name.---------Statistics for the entire class, the low 27% and the high 27%

Answers Selected---Shows how many students in the class and in the low and high groups chose each of the possible responses.

Number Right-------The number of students in each group whose response matches that of the key.

Percent Right ----The percentage of each group that responded correctly to the item

Mean Right---------The average score on the test of those students who chose the correct answer to the question

Mean Wrong---------The average score on the test of those students who chose incorrect responses

Difficulty Index---A measure of the question's difficulty...0 means that no one in the group chose the correct answer; 1.00 indicates that everyone was right. For a three-choice multiple choice item, the difficulty index should be between .45 and .90. For an item with four or more choices, the difficulty index should be between .35 and .85.

Discrimination Index

----Indicates how well the item discriminates between the better and poorer students in a group...locates test questions that were answered correctly by students with overall high scores and answered incorrectly by students with low scores

t-value----------Indicates that if you have 100 test items, all of which have ** in the item analysis printout, approximately 100 of them are good discriminators

Estimate of Test Reliability (internal consistency)
---------measures the ability of a test to measure consistently. The estimate can be as low as 0 or as high as 1.00.

A FORTRAN program was written to find correlations between the students' test scores and (1) number of years of private study; (2) number of years of public school music experience; (3) type of musical organization(s) in which the students participated and (4) medium of musical expreswion.

III. Results of the Test Trial

The Oregon State University Music Department requires courses in music theory and literature for all freshmen. Traditionally, sections of these classes have not been arranged according to indicators of background and achievement, with the result that students and teachers are increasingly frustrated in their efforts to reach competency objectives. Students who arrive with extensive private study and those who were fortunate enough to be offered music theory in high school (and were wise enough to elect it), are in a better position to approach these areas of the discipline than students who are more highly motivated by their interest in the subject than any significant past accomplishment.

Since the dropout and failure rate in the music department is currently greatest in the freshman year, faculty members have expressed an interest in the development of a testing program that will ultimately result in an efficient

class placement, advanced placement, and waiver program for entering freshmen, and, finally, a competency-based curriculum which tests reliably throughout the student's four-year program.

The trial of the CMT with four music classes shows a need for grouping music students by sections in music theory and basic musicianship. Test Scores. Of 89 possible points on this test, the scores in the freshman theory class of thirty-three students ranged from 21-70. Since the test was administered the first week of the term, it is reasonable to expect that the seventeen students whose scores ranged in the top half between 59-70 can be expected to operate at a clear advantage in this class compared to those with scores between 21-59. (Table 1.)

In the two basic musicianship classes the need for sectioning is readily apparent. The forty-five students' scores ranged from 7 to 53 (7-53 in a group of twenty-four students; 17 to 47 in a group of twenty-one students).

Scores for the seventeen juniors in music education reveal that the music department is effectively teaching basic music fundamentals to the freshman and sophomore classes, as the scores here ranged from 64-86 with an overall mean of 72.18. These students indicated that their years of private study and public school music experience prior to their arrival at OSU corresponded to that of currently enrolled freshmen.

Item Analysis. An analysis of test questions shows

that the freshman theory class, Music 111, scored best on questions involving musical symbols. Everyone knew what a # is, for example, and they could all name notes indicated by the G clef. However, they were unfamiliar with syllables in the moveable do system, and also had difficulty with key signatures and visual identification of triad types. The greatest difficulty for this group was the association of major composers and their principal works. No one, for example, knew that Wozzeck was written by Berg, the Mikrokosmos by Bartok, or Gretchen at the Spinning Wheel by Schubert. Only six associated Beethoven with the Eroica Symphony.

The forty-five students who elected Music 101, Basic Musicianship, performed best in these areas: note values and identification of note names. They scored poorly on key signatures and interval and triad identification, but somewhat better on the selection of appropriate time signatures. They encountered such difficulty in the association of major composers and their works that an item analysis in this area is meaningless. Most students did not attempt to answer the questions. Only one of the forty-five students identified Beethoven as the composer of the Eroica Symphony.

The seventeen juniors in music education predictably scored significantly higher than the other groups in all areas. Their weaker performance in music literature, however, brought their mean for the examination down to 72.18.

Had the questions been limited to music theory, their mean would have been significantly higher. Only one of the seventeen associated the Reformation Symphony with Mendelssohn and only three knew the composer of La Boheme. Thirteen correctly associated the Brandenburg Concerti with J.S. Bach and the Prelude to the Afternoon of A Faun with Debussy.

IV. Continuation of the CMT Project

Plans for the further development and refinement of the test of music fundamentals include rewriting or removing those questions which were found by the difficulty index and the discrimination index to be of poor quality as test items. The entire section on music literature is shown to be inappropriate for incoming freshmen.

Computer managed tape deck hardware is available for programming audio tests and lessons, and proposals for funding this equipment are underway. Thus, questions related to music literature will be refashioned to test audio discrimination in listening to representative works from the four periods of western music history. Discrimination of pitch direction, dynamic levels, like and unlike musical elements, stylistic characteristics , and articulation can be examined without reference to a student's cultural or formal musical background, thereby removing some of the biases that are found to exist in the present test.

Other universities interested in the development of placement examinations are invited to add questions to the storage bank, and to participate in on-line generation of tests for their own use. Information about students' performance on the test in areas that are vital to the success of those students as music majors will be shared with the Oregon Administrators' Association to provide assistance in secondary curriculum development in the subject.

SECTION 4 DATE

33 STUDENTS MEAN = 53.61 S.D. = 12.11

TEST SCORE	PERCENTAGE	Z-SCORE	T-SCORE
45	50.6	-0.71	43
63	70.8	.78	58
21	23.6	-2.69	23
64	71.9	.86	59
65	73.0	.94	59
54	60.7	.03	50
62	69.7	.69	57
61	68.5	.61	56
41	46.1	-1.04	40
54	60.7	.03	50
61	68.5	.61	56
62	69.7	.69	57
59	66.3	.45	54
24	27.0	-2.44	26
59	66.3	.45	54
61	68.5	.61	56
59	66.3	.45	54
49	55.1	-0.38	46
63	70.8	.78	58
40	44.9	-1.12	39
48	53.9	-0.46	45
35	39.3	-1.54	35
38	42.7	-1.29	37
60	67.4	.53	55
68	76.4	1.19	62
48	53.9	-0.46	45
57	64.0	.28	53
48	53.9	-0.46	45
63	70.8	.78	58
70	78.7	1.35	64
67	75.3	1.11	61
51	57.3	-0.22	48
49	55.1	-0.38	46

Appendix A: Table 1. Music Theory 111.

INSTRUCTOR HERROLD COURSE SECTION 4 DATE

91 QUESTIONS 89 POINTS 33 STUDENTS MEAN = 53.61 S.D. = 12.11

TEST SCORE	PERCENTILE	Z-SCORE	T-SCORE	PERCENT	FREQUENCY	CUM. FREQ.	FREQUENCY DISTRIBUTION (EACH * REPRESENTS ONE STUDENT) 123456789*
21	1-	-2.69	23	3.03%	1	1	*
22	2	-2.61	24	0%	0	1	
23	2	-2.53	25	0%	0	1	
24	3	-2.44	26	3.03%	1	2	*
25	5	-2.36	26	0%	0	2	
26	5	-2.28	27	0%	0	2	
27	5	-2.20	28	0%	0	2	
28	5	-2.11	29	0%	0	2	
29	5	-2.03	30	0%	0	2	
30	5	-1.95	31	0%	0	2	
31	5	-1.87	31	0%	0	2	
32	5	-1.79	32	0%	0	2	
33	5	-1.70	33	0%	0	2	
34	5	-1.62	34	0%	0	2	
35	6	-1.54	35	3.03%	1	3	*
36	8	-1.45	35	0%	0	3	
37	8	-1.37	36	0%	0	3	
38	9	-1.29	37	3.03%	1	4	*
39	11	-1.21	38	0%	0	4	
40	12	-1.12	39	3.03%	1	5	*
41	15	-1.04	40	3.03%	1	6	*
42	17	-0.96	40	0%	0	6	
43	17	-0.88	41	0%	0	6	
44	17	-0.79	42	0%	0	6	
45	18	-0.71	43	3.03%	1	7	*
46	20	-0.63	44	0%	0	7	
47	20	-0.55	45	0%	0	7	
48	24	-0.46	45	9.09%	3	10	***
49	32	-0.38	46	6.06%	2	12	**
50	35	-0.30	47	0%	0	12	
51	36	-0.22	48	3.03%	1	13	*
52	38	-0.13	49	0%	0	13	
53	38	-0.05	49	0%	0	13	
54	41	.03	50	6.06%	2	15	**
55	44	.12	51	0%	0	15	
56	44	.20	52	0%	0	15	
57	45	.28	53	3.03%	1	16	*
58	47	.36	54	0%	0	16	
59	52	.45	54	9.09%	3	19	***
60	58	.53	55	3.03%	1	20	*
61	64	.61	56	9.09%	3	23	***
62	71	.69	57	6.06%	2	25	**
63	79	.78	58	9.09%	3	28	***
64	85	.86	59	3.03%	1	29	*
65	88	.94	59	3.03%	1	30	*
66	89	1.02	60	0%	0	30	
67	91	1.11	61	3.03%	1	31	*
68	94	1.19	62	3.03%	1	32	*
69	95	1.27	63	0%	0	32	
70	97	1.35	64	3.03%	1	33	*

123456789*

MEDIAN = 59

Appendix A: Table 2. Music Theory
111

SECTION 3 DATE

24 STUDENTS MEAN = 30.00 S.D. = 14.70

TEST SCORE	PERCENTAGE	Z-SCORE	T-SCORE
7	7.9	-1.56	34
18	20.2	-0.82	42
22	24.7	-0.54	45
46	51.7	1.09	61
10	11.2	-1.36	36
31	34.8	.07	51
42	47.2	.82	58
41	46.1	.75	57
53	59.6	1.56	66
47	52.8	1.16	62
13	14.6	-1.16	38
17	19.1	-0.88	41
51	57.3	1.43	64
44	49.4	.95	60
51	57.3	1.43	64
48	53.9	1.22	62
21	23.6	-0.61	44
25	28.1	-0.34	47
23	25.8	-0.48	45
14	15.7	-1.09	39
24	27.0	-0.41	46
22	24.7	-0.54	45
19	21.3	-0.75	43
31	34.8	.07	51

Appendix B: Table 1. Basic Musicianship 101.

INSTRUCTOR HERROLD COURSE SECTION 3 DATE

91 QUESTIONS 99 POINTS 24 STUDENTS MEAN = 30.00 S.D. = 14.70

TEST SCORE	PERCENTILE	Z-SCORE	T-SCORE	PERCENT	FREQUENCY	CUM. FREQ.	FREQUENCY DISTRIBUTION (EACH * REPRESENTS ONE STUDENT) 123456789*
7	1-	-1.56	34	4.17%	1	1	*
8	2	-1.50	35	0%	0	1	
9	2	-1.43	36	0%	0	1	
10	4	-1.36	36	4.17%	1	2	*
11	6	-1.29	37	0%	0	2	
12	6	-1.22	38	0%	0	2	
13	8	-1.16	38	4.17%	1	3	*
14	13	-1.09	39	4.17%	1	4	*
15	15	-1.02	40	0%	0	4	
16	15	-0.95	40	0%	0	4	
17	17	-0.88	41	4.17%	1	5	*
18	21	-0.82	42	4.17%	1	6	*
19	25	-0.75	43	4.17%	1	7	*
20	27	-0.68	43	0%	0	7	
21	29	-0.61	44	4.17%	1	8	*
22	35	-0.54	45	8.33%	2	10	**
23	42	-0.48	45	4.17%	1	11	*
24	46	-0.41	46	4.17%	1	12	*
25	50	-0.34	47	4.17%	1	13	*
26	52	-0.27	47	0%	0	13	
27	52	-0.20	48	0%	0	13	
28	52	-0.14	49	0%	0	13	
29	52	-0.07	49	0%	0	13	
30	52	0	50	0%	0	13	
31	56	.07	51	8.33%	2	15	**
32	60	.14	51	0%	0	15	
33	60	.20	52	0%	0	15	
34	60	.27	53	0%	0	15	
35	60	.34	53	0%	0	15	
36	60	.41	54	0%	0	15	
37	60	.48	55	0%	0	15	
38	60	.54	55	0%	0	15	
39	60	.61	56	0%	0	15	
40	60	.68	57	0%	0	15	
41	63	.75	57	4.17%	1	16	*
42	67	.82	58	4.17%	1	17	*
43	69	.88	59	0%	0	17	
44	71	.95	60	4.17%	1	18	*
45	73	1.02	60	0%	0	18	
46	75	1.09	61	4.17%	1	19	*
47	79	1.16	62	4.17%	1	20	*
48	83	1.22	62	4.17%	1	21	*
49	85	1.29	63	0%	0	21	
50	85	1.36	64	0%	0	21	
51	90	1.43	64	8.33%	2	23	**
52	94	1.50	65	0%	0	23	
53	96	1.56	66	4.17%	1	24	*

123456789*

MEDIAN = 24

Appendix B: Table 2.
Basic Musicianship 101

SECTION 1 DATE

21 STUDENTS MEAN = 26.43 S.D. = 8.49

TEST SCORE	PERCENTAGE	Z-SCORE	T-SCORE
19	21.3	-0.88	41
25	28.1	-0.17	48
20	22.5	-0.76	42
20	22.5	-0.76	42
21	23.6	-0.64	44
20	22.5	-0.76	42
34	38.2	.89	59
25	28.1	-0.17	48
24	27.0	-0.29	47
45	50.6	2.19	72
17	19.1	-1.11	39
47	52.8	2.42	74
25	28.1	-0.17	48
23	25.8	-0.40	46
36	40.4	1.13	61
26	29.2	-0.05	49
31	34.8	.54	55
35	39.3	1.01	60
19	21.3	-0.88	41
23	25.8	-0.40	46
20	22.5	-0.76	42

Appendix C: Table 1. Basic Musicianship 101.

INSTRUCTOR HERROLD COURSE SECTION 1 DATE

91 QUESTIONS 89 POINTS 21 STUDENTS MEAN = 26.43 S.D. = 8.49

TEST SCORE	PERCENTILE	Z-SCORE	T-SCORE	PERCENT	FREQUENCY	CUM. FREQ.	FREQUENCY DISTRIBUTION (EACH * REPRESENTS ONE STUDENT)
							123456789*
17	1-	-1.11	39	4.76%	1	1	*
18	2	-0.99	40	0%	0	1	
19	7	-0.88	41	9.52%	2	3	**
20	21	-0.76	42	19.05%	4	7	****
21	33	-0.64	44	4.76%	1	8	*
22	36	-0.52	45	0%	0	8	
23	40	-0.40	46	9.52%	2	10	**
24	48	-0.29	47	4.76%	1	11	*
25	57	-0.17	48	14.29%	3	14	***
26	67	-0.05	49	4.76%	1	15	*
27	69	.07	51	0%	0	15	
28	69	.19	52	0%	0	15	
29	69	.30	53	0%	0	15	
30	69	.42	54	0%	0	15	
31	71	.54	55	4.76%	1	16	*
32	74	.66	57	0%	0	16	
33	74	.77	58	0%	0	16	
34	76	.89	59	4.76%	1	17	*
35	81	1.01	60	4.76%	1	18	*
36	86	1.13	61	4.76%	1	19	*
37	88	1.25	62	0%	0	19	
38	88	1.36	64	0%	0	19	
39	88	1.48	65	0%	0	19	
40	88	1.60	66	0%	0	19	
41	88	1.72	67	0%	0	19	
42	88	1.83	68	0%	0	19	
43	88	1.95	70	0%	0	19	
44	88	2.07	71	0%	0	19	
45	90	2.19	72	4.76%	1	20	*
46	93	2.31	73	0%	0	20	
47	95	2.42	74	4.76%	1	21	*
							123456789*

MEDIAN = 24

Appendix C: Table 2.
Basic Musicianship 101.

INSTRUCTOR HERROLD COURSE SECTION 2 DATE

91 QUESTIONS 89 POINTS 17 STUDENTS MEAN = 72.18 S.D. = 6.15

TEST SCORE	PERCENTILE	Z-SCORE	T-SCORE	PERCENT	FREQUENCY	CUM. FREQ.	FREQUENCY DISTRIBUTION (EACH * REPRESENTS ONE STUDENT)
							123456789*
64	3	-1.33	37	11.76%	2	2	**
65	12	-1.17	38	5.88%	1	3	*
66	15	-1.00	40	0%	0	3	
67	18	-0.84	42	5.88%	1	4	*
68	24	-0.68	43	5.88%	1	5	*
69	29	-0.52	45	5.88%	1	6	*
70	35	-0.35	46	5.88%	1	7	*
71	41	-0.19	48	5.88%	1	8	*
72	47	-0.03	50	5.88%	1	9	*
73	56	.13	51	11.76%	2	11	**
74	65	.30	53	5.88%	1	12	*
75	71	.46	55	5.88%	1	13	*
76	76	.62	56	5.88%	1	14	*
77	82	.78	58	5.88%	1	15	*
78	85	.95	59	0%	0	15	
79	85	1.11	61	0%	0	15	
80	85	1.27	63	0%	0	15	
81	85	1.44	64	0%	0	15	
82	85	1.60	66	0%	0	15	
83	88	1.76	68	5.88%	1	16	*
84	91	1.92	69	0%	0	16	
85	91	2.09	71	0%	0	16	
86	94	2.25	72	5.88%	1	17	*
							123456789*

MEDIAN = 72

Appendix D: Table 1. Juniors in Music Education
Music in the Elementary School 372